The Effect of Minimum Wages on Youth Employment in Canada: A Panel Study

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May 1998

* I am very grateful to Michael Baker and Dwayne Benjamin for pointing out this topic and their continued guidance in conducting this study. I thank Felice Martinello, and seminar participants at Toronto, and the 1996 Canadian Economics Association Meetings for helpful comments. I also thank the Canadian International Labour Network for financial support.

Abstract

Previous U.S. panel estimates of minimum wage effects have been criticized on the grounds that their identification rests on comparisons of 'low wage' and 'high wage' workers. The institutional structure of minimum wage laws in Canada permits an evaluation of this objection. Using Canadian panel data for 1988-90, I compare estimates of the minimum wage effect based on the traditional U.S. panel methodology to those based on samples of 'low wage' workers exclusively. The results would appear to vindicate the critics: the estimates from the latter approach are small and statistically insignificant. Low wage workers, however, are in turn a heterogeneous group. For 'transitory' low wage workers, who have less than 3 quarters of low wage employment in the sample period, the effects of the minimum wage are virtually zero. Yet, there is a significant disemployment effect for the complementary group.

I. Introduction

In the conventional supply-and-demand framework, an increase in the minimum wage reduces employment for those workers with wages at or near the minimum level. Most of the early U.S. and Canadian empirical evidence is consistent with this 'standard prediction' of a negative employment effect (Brown 1988, Swidinsky 1980, Schaafsma and Walsh 1983). In general, aggregate studies using time series data from the 1970s and early 1980s conclude that a 10 percent increase in minimum wage decreases the teenage employment by 1 to 3 percent[1] (Brown 1988). The validity of the time-series evidence, however, has recently been called into question. A number of studies (Grenier and Séguin 1991, Wellington 1991, Card 1992a and 1992b, Katz and Krueger 1992, Card and Krueger 1994, Machin and Manning 1994) suggest that the employment effect of the minimum wage is insignificant or perhaps marginally positive[2].

A number of attempts have been made to bring these divergent results into line. One strand of the reconciliation examines workers' employment patterns before and after an increase in the minimum wage using individual-level panel data. Linneman (1982) is an early study adopting this approach. More recently, Currie and Fallick (1996) examine increases in the U.S. minimum wage in 1980 and 1981 using this framework. They find that young people who are 'bound' by the two minimum wage changes (i.e., their current wage rate is between the old and new minimum) are 3 percent less likely to be employed in the following year.

Both the Currie and Fallick results and those in Linneman's study have been criticized on the grounds that panel estimates of minimum wage effects are biased due to the lack of a suitable control group. Since the minimum wage in the U.S. is under the jurisdiction of the federal government, all workers in the covered sectors with wage rates near the minimum are affected simultaneously by a change in the legislation. Therefore,

[1] The effects for young adults are often smaller and insignificant, reflecting their smaller representation in the minimum wage population

there are few candidates to serve as a control for unrelated concurrent changes in labour market outcomes; typically higher wage workers are used as a control group. In other words, the panel results are based on a comparison of 'low wage' and 'high wage' individuals. It is possible therefore, that the panel estimates partly capture any differences in employment stability between the two wage groups. For instance, Card and Krueger (1995a, p. 224) observe:

> *High-wage workers provide a poor comparison group for studying the employment histories of low-wage workers. The insight from the "natural-experiments" approach to empirical research is that it is crucial to have a control group representing the experiences that the affected group of workers would have had in the absence of the minimum wage increase.*

Obtaining an appropriate control group becomes the central challenge for panel studies of minimum wage. Perhaps the most convincing control group that has been used in U.S. studies is low wage workers in the uncovered sectors. For example, Ashenfelter and Card (1981) re-examine Linneman's analysis, comparing low wage workers in the covered sectors to those in uncovered sectors. As reported in Card and Krueger (1995a), their results indicate that both groups of low wage workers share similar employment experiences following the minimum wage increases in 1974 and 1975. This suggests that the significant disemployment effect of the minimum wage found in Linneman's study is a result of the heterogeneity between high wage and low wage individuals. Canada, arguably, provides an even better environment in which to address this issue. In contrast to the U.S., the minimum wage in Canada is under provincial jurisdiction. Therefore, for an increase in the minimum wage in a given province, low wage workers in other provinces can serve as the control group. In this case, the minimum wage effect is identified by variation between two groups of low wage individuals with comparable experience.

Using data from the Labour Market Activity Survey, I examine the effects of provincial minimum wage increases in Canada between 1988 and 1990. Over the sample

[2] In addition, Card and Krueger (1995b) argue that the time-series literature is affected by publication bias, leading to a tendency for significant negative results to be over-represented in the published

period, there were a total of 19 separate changes in minimum wage across the 10 provinces. I begin by adopting the U.S. panel methodology: that is, including high wage individuals in the control group. Fixed effect estimates of the effect of the minimum wage on employment probability are negative and significant for both teens and young adults. This result is consistent with other U.S. panel estimates of minimum wage effect. I next replicate the analysis limiting the control group to low wage workers in provinces with no minimum wage change. The resulting estimates of the minimum wage effect are insignificant and virtually zero. The difference in the results across these two methods appears to validate the criticism of past panel studies of minimum wage. The negative and significant estimates from the first method are driven by differences in employment stability between high wage and low wage workers.

A closer examination of the low wage sample, however, indicates that the minimum wage has different impacts within this group of seemingly homogenous workers. For 'transitory' low wage workers, who have less than 3 quarters of low wage employment over the sample period, the minimum wage effect is small and insignificant. In contrast, the minimum wage effect is both statistically and economically significant for those with longer low wage employment histories. For these workers with more than 3 quarters of low wage employment, teens are 7 percent less likely to be re-employed after a 8.4 percent increase in the minimum. The impact on young adults is even larger at 10 percent. An account of the difference in the minimum wage effect across these two groups is that most of the 'transitory' low wage workers are either full time students working in low paid summer jobs or 'high wage' workers temporary trapped in low wage positions. Thus, their current wage rates are likely lower than their marginal productivity. In terms of the target group in a supply-and-demand framework, they are less likely to be affected by the minimum wage.

This paper proceeds as follows: Section 2 describes the key aspects of the longitudinal data set. Since no micro panel study has previously been conducted for Canada, Section 3.1 replicates the U.S. panel studies by including high wage individuals. In Section 3.2, I limit my sample to only low wage observations in order to determine

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literature.

whether the results are sensitive to the definition of the control group. Section 4 contains some concluding remarks.

II. Data

The Labour Market Activity Survey (LMAS) is a longitudinal labour market data set which is a representative of the Canadian population[3]. Individuals are initially (1988) sampled through an addendum to the Labour Force Survey. They are then recontacted annually (1989 and 1990) and questioned about their labour market behaviour in the intervening period. In addition to general demographic information, the survey contains detailed employment information, such as weekly employment status and the beginning and end dates of different non-employment spells. Since the primary objective of this paper is to retrieve panel estimates of minimum wage effects on youth employment, only people between ages 16 and 24 in 1988 are included in my sample[4].

The LMAS provides weekly employment status for each individual and it is possible to construct a weekly panel on the labour market activity of each individual every year. However, control variables, such as provincial unemployment rate and consumer price index, are provided at most on a monthly basis, and changes in the main variable of interest, the minimum wage, are even less frequent. I therefore work with a quarterly data which captures each individual's employment status[5] at the middle of each quarter[6]; that is, at most 12 observations for each individual during the three year sample period. Also, I exclude any individual who moves to the Yukon and Northwest Territories over the

[3] Individuals living in the Yukon and Northwest Territories are not sampled in the LMAS.

[4] Because my sample 'ages' over time, these individuals will be 18-26 by the last year of the panel.

[5] The LMAS attempts to decompose nonemployment into three states: unemployment with job search, unemployment without job search and not in the labour force. As pointed out by Jones and Riddell (1994), there are problems with this filter of the data. It may lead to biased measurement of the incidence and duration of nonemployment when there are only two meaningful nonemployment states. However, the LMAS longitudinal file provides a perfect forum for my analysis that only focuses on movements between employment and nonemployment in a two-state framework.

[6] That is observations from the 7th, 20th, 33rd and 46th week.

sample period because a complete series of all the control variables is not available for these areas.

I focus on the effect of the minimum wage on the transition from employment to nonemployment. Therefore, I confine my sample to those who are employed with a positive wage rate in a given quarter. In the LMAS, an hourly wage rate may not be directly reported by the individual. Any wage or salary, which is not reported on an hourly basis, is converted to an hourly equivalent rate as the usual wage or salary (e.g. daily, weekly or monthly) divided by the total hours worked. Observations with hourly wages lower than $2 or higher than $50 are excluded since they likely result from measurement error, especially for young adults. I also note that individuals with multiple jobs may have more than one hourly wage rate for a given period. Different weighted averages of the wage rates for different jobs can be used as the final measure of individual wage at a given time. It is reasonable to assume that the likelihood of losing a job decreases as the wage rate increases. Therefore, for those who hold more than one job in a period, what I am really interested in is to see whether they will lose their highest paid jobs and become unemployed as a result of a minimum wage increase. Taking the highest among all the wage rates as the final measure seems to be more appropriate[7].

My full sample contains 71002 observations on 9379 individuals. There are 4379 teenagers between the ages of 16 to 19 (in 1988), while the remaining 5000 are young adults of ages 20 to 24. The percentage male are 52.3 and 50.1 for teenagers and young adults respectively. Descriptive statistics for the pooled cross section (1988 to 1990) are presented in Table 1. Not surprisingly, the marriage rate and education level of young adults are significantly higher than for teens. Young adults work longer hours at higher wages. The mean wages are 6.78 and 9.22 for the teens and young adults respectively. In addition, the average employment history of young adults is almost half a year longer than for teens. Young adults have 8.4 quarters employed throughout the three year sample period while the mean is only 6.6 for teens. As shown in Figure 1, the sample distribution of the number of total employment periods for young adults is heavily skewed to the right.

[7] In fact, I have replicated the empirical analysis with alternative definitions, such as the lowest and the simple average of all the wage rates. The results are very robust to these changes.

More than 25 percent of the young adults are employed in all 12 quarters between 1988 and 1990.

Using individual wage rates, I identify individuals who are directly affected by an increase in the minimum wage. Formally, given that there is a minimum wage increase at t, individuals are defined 'at risk' if their wage rate at period t-1 is between the old minimum ($MinW_{t-1}$) and the new minimum ($MinW_t$). The percentage of teens and young adults, who are considered 'at risk' by this definition, is reported in Table 2. For teens, the percentage ranges from 2.8% (2nd quarter of 1990 in British Columbia) to 17.9% (1st quarter of 1989 in Nova Scotia). As expected the percentage for young adults is always lower, it ranges from 0.6% (2nd quarter of 1988 in Newfoundland) to 7.7% (1st quarter of 1988 in Nova Scotia). On average 9.5% of the teens and 2.4% of the young adults are considered 'at risk'.

As noted above, over the three year sample period, there were 19 minimum wage changes in different provinces. As shown in Figure 2, there has been at least one minimum wage increase in all provinces, except Manitoba. We might expect the nominal minimum wage to trend upward over the period, as provincial governments may adjust the level in order to match the inflation rate. On the other hand, there is no common pattern in the trends of the relative minimum wage, measured as the ratio of the nominal minimum wage to the average provincial manufacturing wage[8] (MinW/AvgW). This is in part due to the fact that there has been distinct minimum wage policies in the provinces over the period[9]. As expected, provinces like Ontario and Quebec, which revised their minimum wages yearly during the sample period, have a more stable pattern in the relative minimum wage.

[8] It is the provincial average manufacturing wage including overtime.

[9] Besides minimum wage policy, AvgW differs across provinces. This may also lead to difference in (MinW/AvgW). For example, the exceptionally high relative minimum wage in P.E.I. is due to its relatively low manufacturing wage compared with other provinces.

III. Empirical Framework

1. The 'Traditional' Approach - All Employed Individuals

If minimum wages and employment are negatively correlated, an increase in minimum wage will increase the likelihood of those currently employed being laid off or unable to find new jobs through regular turnover in the next period. In other words, the probability of shifting from employment to nonemployment increases. Given that an individual is employed in period t-1, the probability of being employed in the next period is modeled as a function of a set of control variables and the variable measuring exposure to the minimum wage increase.

$$\Pr(S^{j}_{i,t} = 1 \mid S^{j}_{i,t-1} = 1) = f(\text{AtRisk}^{j}_{i,t}, I^{j}_{i,t}, V^{j}_{t}, D_{p}, D_{y}, D_{s}) + \varepsilon^{j}_{i,t} \qquad (1)$$

$S^{j}_{i,t}$ is the employment status of individual i living in province j at time t. The binary dependent variable ($E^{j}_{i,t}$) = 1 if the individual, who is employed at t-1 ($S^{j}_{i,t-1}$ = 1) is also employed at t ($S^{j}_{i,t}$ = 1), and = 0 if nonemployed at t. The dummy variable, $\text{AtRisk}^{j}_{i,t}$, is used as the control for minimum wage. $\text{AtRisk}^{j}_{i,t}$ = 1 if the wage rate of individual i at period t-1 is between the old minimum (MinW_{t-1}) and the new minimum (MinW_{t}) when there is a minimum wage increase in province j at t, and = 0 otherwise[10]. Thus, individuals with wages outside this range ([MinW_{t-1}, MinW_{t}]), as well as all workers in other provinces with no minimum wage change, are used as the control group for other changes in the labour market. This 'traditional' approach have been adopted in other U.S. panel studies, such as Currie and Fallick (1996)[11].

[10] $\text{AtRisk}^{j}_{i,t}$ = 0 if (i) there is no minimum wage in province j at t or (ii) the wage rate of individual i is below the old minimum (MinW^{j}_{t-1}) or above the new minimum (MinW^{j}_{t}).

[11] There is a difference between my approach and the framework in Currie and Fallick. They compare the 'at risk' individuals to those who are unlikely to be affected by an increase in the minimum wage. As noted above, my comparison is not limited to individuals within the same province who are not likely to be affected, but also uses individuals in other provinces with no minimum wage change. It is possible to replicate the work of Currie and Fallick by estimating equation (1) separately for each province. However, the results (not reported) are not particularly informative because of the very small number of 'at risk' individuals in many provinces.

The demographic information for individual i (marital status, education level and gender) is represented by $I^{j}_{i,t}$. One point worth mentioning is that labour force experience or potential experience is not included as one of the control variables. Because the LMAS records age and education level by categories, it is not possible to infer the exact age and years of schooling of each individual from this classification. V^{j}_{t} represents the economic environment of province j at time t, which includes the real GDP at time t, and the change in unemployment rate of males of prime age (25 to 54) between period t-1 and t. D_p are provincial dummy variables to capture the provincial fixed effects. Dummy variables, D_y and D_s, are year and season effects respectively. Detailed descriptions of each group of independent variables are given in Table 3.

A set of estimates of the linear probability model given in equation (1) is reported in Table 4. Starting with the OLS estimates, the coefficient on $AtRisk_{i,t}$ is negative and statistically significant[12] for both teens and young adults. On average, 'at risk' teenagers are 6.9 percent less likely to be re-employed after a 8.4 percent[13] increase in minimum wage. The impact is even greater on young adults at 14.8 percent[14].

The OLS estimates are subject to the same criticism leveled at other panel studies of minimum wage. The control group consists primarily of high wage workers. If high wage workers are 'better' than low wage workers in some unobserved quality that has a positive effect on employment and earnings, the results from the OLS estimation are biased. More precisely, the estimates of the minimum wage effects also capture these differences between high and low wage workers. In order to control for the unobserved heterogeneity between the two wage groups, I re-estimate equation (1) using a fixed effect (FE) model. To ensure that there is sufficient variation in the explanatory variables, only individuals with 3 or more observations are included in my sample for this part of the

[12] Standard errors in all OLS and FE models have been corrected by the White (1980) procedure.

[13] This is the average percent increase of all 19 provincial minimum wage changes weighted by the number of 'at risk' teens in each change.

[14] The weighted average percent increase in the minimum wage for young adults is 7.7%. Although both teens and young adults are affected by the same minimum wage changes, the weighted average percent increase is different for each age group. This is because the number of 'at risk' teens is different from the number of 'at risk' young adults.

analysis[15]. Results are shown in the second and fifth columns of Table 4. For both age groups, the FE estimates are still negative and statistically significant, but their magnitude is slightly less than the OLS estimates. Although the differences are not substantial, there is indeed some indication that the unobserved heterogeneity across individuals is correlated with inclusion in the 'at risk' set[16]. The orthogonality of the unobserved heterogeneity and the regressors can be formally tested by the Hausman specification test. The random effect estimates for comparison to the fixed effect estimates are reported in columns 3 and 6. At 5 percent confidence level, the test[17] rejects the hypothesis of no correlation between the individual effects and other regressors for both age groups.

Another point worth mentioning is that the minimum wage effect is always greater for young adults' employment than for teens. This may be due to the fact that current wage rate is a noisy measure of an individual's productivity, especially for teens. Some good quality teenage workers may be 'trapped' in minimum wage jobs because that is where most employment opportunities are (e.g., in the fast food industry). The current wage rates of these teens do not necessarily reflect their potential productivity. On the other hand, given that the average young adult wage is much higher than the teenage average, young adults in the 'at risk' group are more likely to have really poor labour market prospects. Therefore, they may be more 'vulnerable' to the impact of minimum wage[18].

Based on the results in Table 4, the conclusion is that the minimum wage has a significant negative effect on the employment probability of the 'at risk' group. After

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[15] As a result, 1605 observations are dropped from the original sample.

[16] The less negative coefficient in FE estimation may also be measurement error which biases the coefficients towards zero. In the LMAS, the wage rate for a particular job is measured annually. Therefore, measurement error may exist in quarterly observations, especially in defining the 'at risk' group.

[17] The Hausman test statistics, distributed $\chi^2(24)$, are 622 for teens and 128 for young adults. Both are greater than critical value at 5%.

[18] In fact, I have replicated the analysis on adults between the ages of 25 and 34. In this case, the effect of minimum wage on the 'at risk' group is slightly greater than for young adults (age 20-24). The minimum wage effect on re-employment probability ranges from 10 to 12 percent. This further confirms the idea that an individual considered 'at risk' in a group with a higher average wage is more likely to be a lower 'quality' worker.

controlling for the unobserved heterogeneity across individuals, 'at risk' teens are 6 percent less likely to be employed after a 8.4 percent increase in minimum wage. The impact on young adults employment is even larger at more than 10 percent[19]. These results are consistent with other U.S. panel studies, such as Currie and Fallick (1996). Using a similar specification[20], they find that 'at risk' teenagers are 3 percent less likely to be employed as a result of a 7 percent[21] increase in the U.S. federal minimum wage in 1980 and 1981. Canada would appear to share a comparable experience to the U.S.

More generally, we must be careful comparing this set of results with other minimum wage studies. First, I am focusing on the disemployment effect on the 'at risk' workers who represent a very small portion of the entire youth population. In my sample, 9.5 percent of the teens and 2.4 percent of the young adults are considered 'at risk'. Therefore, even though an increase in the minimum wage has a negative and significant impact on 'at risk' employment, it is very unlikely to lead to a reduction in overall youth employment. Second, the estimated minimum wage effect only refers to the transition from employment to non-employment. Ideally, I should also look at the transition from non-employment to employment in order to obtain a complete picture of the minimum wage effect on employment probability. However, I cannot use current wage rates to identify the non-employed as 'at risk'.

[19] See footnote 14.

[20] Instead of the dummy variable 'At Risk', they use a continuous variable WageGap to control for the effect of minimum wage. $WageGap_{i,t}$ is defined as the difference between the minimum wage at t and the wage rate of individual i at t-1 if he is considered as 'at risk' in the minimum wage change at t. $WageGp_{i,t} = 0$ otherwise. Conceptually, $WageGp_{i,t}$ is just a refinement of $AtRisk_{i,t}$. $WageGp_{i,t}$ further distinguishes the 'at risk' individuals based on the difference between their current wages and the minimum. I have also replicated the empirical analysis using WageGap. The results (not reported) are robust to this change in specification. The coefficients on WageGap are all significant and negative. For teens, the estimates imply that on average the 'at risk' group is 4 to 5 percent less likely to be employed in the following year if there is a minimum wage increase. The implied effect on young adults is larger at -9 to -11 percent.

[21] Currie and Fallick do not report the average percent increase in minimum wage explicitly equal to 7%. From Table 1 in their paper, I calculate the average percent increase in the minimum in 1980 and 1981 weighted by the number of 'bound' individuals in each change.

2. A Refinement of the Control Group - Only 'Low Wage' Individuals

As noted above, most criticism of the 'traditional' panel model focuses on the definition of the control group. Since the control group in the previous section is dominated by the high wage individuals outside the 'at risk' range [$MinW_{t-1}$, $MinW_t$], the coefficient on $AtRisk^j_{i,t}$ not only captures the effect of minimum wages on the re-employment probability, but also any differences in employment stability between low wage and high wage individuals. If high wage workers always have higher employment rates than low wage workers, the estimates of the minimum wage effect in the previous section may be biased away from zero. One way to address this problem is to exploit the panel nature of the data and estimate a FE model, as reported in the previous section. Yet, assuming the individual effects for youth are fixed over time is subject to question. In commenting on Currie and Fallick (1996)[22], Card and Krueger (1995a, p. 228) argue:

> *... there is little reason to believe that, for the NLSY sample, the unobserved individual effects that are correlated with base-year pay are fixed, or even approximately fixed, over time. ... In such a sample, one would expect productivity, wages, and employment rates to evolve rapidly over time, as workers move in and out of school and shop among jobs.*

An alternative solution to this heterogeneity problem is to obtain a better control group. That is replacing the high wage workers with a group of workers with wage rates comparable to the 'at risk' individuals but who are not affected by the increase in the minimum wage. The comparison group in the analysis of the previous section consists of two different types of people: those outside the 'at risk' range [$MinW_{t-1}$, $MinW_t$] in the province with an increase in the minimum, and all workers in other provinces with no minimum wage change. In this section, I focus on the 'low wage' individuals from the latter group since they are potentially a good control for the 'at risk' individuals. They have similar wages to the 'at risk' workers and therefore are more likely to have similar employment stability.

[22] In addition to the basic FE model, they include a dummy variable for workers with wage rates no more than 15 cents above the minimum. Also, they decompose the control into 3 different groups. Their results indicate a negative minimum wage effect even after employed these different treatments for the unobserved heterogeneity.

There are at least three ways to define a control group of low wage workers in a province where there is no change in the minimum wage. First, we could consider a worker as low wage if his wage rate is within a certain fixed dollar interval above the existing minimum in his province. A second definition would be to replace the fixed dollar interval by a fixed percentage interval. By these two definitions, the wage interval is insensitive to the minimum wage changes in other provinces. Therefore, instead of imposing a time invariant margin, a changing interval could be used. It could be equal to the maximum/minimum percentage or dollar change in the minimum wage observed concurrently in other provinces[23]. In the following analysis, I simply choose a fixed dollar interval of 25 cents since two thirds[24] of the increases in the minimum wages observed in the sample period are exactly this amount[25]. Formally, individuals in province j are considered as a low wage control, i.e., $AtRisk^{j}_{i,t} = 0$, if their wages are between $MinW^{j}_{t-1}$ and $MinW^{j}_{t-1} + 0.25$ when the minimum wage of province j remains unchanged at time t. It is important to note that more than 93 percent of the control group used in the previous section is excluded by this definition[26]. A detailed decomposition of the entire sample is presented in Figure 3.

Equation (1) is re-estimated using this alternative methodology. The results are presented in Table 5. Again, I begin with a linear probability model estimated by OLS. For teens, the estimate of the minimum wage effect is negative, but virtually zero. As well, the standard error is much greater than the estimate. For young adults, the estimate is negative with greater precision and magnitude, but still is not significant even at 10 percent confidence level. Therefore, the OLS evidence would seem to confirm the criticism of previous U.S. panel studies. Once the comparison group is restricted to low

[23] Mathematically, three low wage control definitions are: (i) $MinW^{j}_{t-1}$ + a fixed amount, (ii) $MinW^{j}_{t-1} \times (1$ + a fixed % change), and (iii) $MinW^{j}_{t-1}$ + maximum/minimum dollar change of the minimum in other provinces or $MinW^{j}_{t-1} \times (1$ + maximum/minimum % change of the minimum).

[24] 12 of 19 provincial minimum wage changes are exactly $0.25.

[25] I have replicated the analysis with all 3 measures. The results (not reported) are similar to those reported in Table 5.

[26] As shown in Figure 3, 60296 are excluded from the control.

wage individuals, there is no minimum wage effect on youth employment, even for those 'at risk'.

The purpose of focusing on low wage workers is to eliminate the unobserved heterogeneity among workers. The treatment and the control groups are supposed to have comparable employment experience ex ante. Therefore, we would expect the results from a FE model to be very similar to the OLS. Surprisingly however, the FE model provides a very different picture. The results are reported in the second and fifth columns of Table 5. Here the estimated parameters on $AtRisk^{j}_{i,t}$ are negative and statistically significant for both age groups.

Unless there is a strong reason to believe that individual fixed effects are correlated with changes in the provincial minimum wage, the difference between the OLS and FE estimates cannot be solely explained by unobserved heterogeneity among workers. Another possible explanation is sample selection. In order to ensure sufficient variation in the explanatory variables, FE estimations typically exclude some of the observations from the original OLS sample. For example, individuals with only one observation in an unbalanced panel have to be dropped. If the excluded individuals are systematically different from those in the FE sample, the difference between the OLS and FE estimates does not necessarily reflect the individual effects, but the sample selection. In my FE sample, only individuals with three or more observations are included. As a result, 40 percent[27] of the OLS sample is excluded. In order to identify the effects of this sample selection, I present OLS estimates using the FE sample. The results for both age groups, reported in columns 3 and 6, are very similar to the FE estimates: The estimated minimum wage effects are negative and statistically significant. Thus the difference between the FE estimates and the OLS estimates in columns 1 and 4 is due to sample selection rather than heterogeneity. This further supports the argument that low wage workers from provinces with no minimum wage change provide a good control for the 'at risk' individuals. Because the variation in the minimum wage in the sample is geographical, it would be surprising if it was correlated with individual effects.

[27] 40.4% of the teens and 39% of the young adults sample are excluded.

The estimates from the different sub-groups of the low wage sample indicate that the minimum wage has a significant effect on individuals with three or more low wage employments (FE sample), but not on the complementary group. This implies that the worker's wage is not a sufficient statistic to identify those who are directly affected by the minimum wage. These groups of low wage individuals differ in two main areas. First, individuals excluded from the FE sample have a shorter average employment history. Including all low and high wage employments, they are employed for only 5.7 quarters throughout the three year sample period, while the mean in the FE sample is 8.1 quarters. Second, they appear to be transitory low wage workers. Only one in three of their employments is considered low wage[28]. I next re-examine these excluded individuals to discover how the minimum wage effect is correlated with the number of total employment periods and the percentage of low wage employment. They may be sub-divided into the following two groups:

i) individuals with low wage employments < 3 and total employments < 3

One reason workers will have fewer than three periods of low wage employment is that they are employed in only one or two quarters throughout the entire sample period. A prominent feature of this group is that they have an extremely high job separation rate. On average, given that they are employed in the present period, the probability of being nonemployed in the next period is 70 percent. Considering that my sample only consists of young people between the ages of 16 and 24, there are at least two hypotheses to account for short employment histories combined with high separation rates. One is that this group is comprised of low wage workers with extremely poor labour market prospects. Alternatively, this group could be full time students who only work in low paid jobs during the summer. One way to distinguish these two hypotheses is by looking at the distribution of their employment periods. We would expect the employment of those in the former category to be evenly distributed throughout the sample period, and a strong seasonal pattern for the latter. As shown in Figure 4, three large spikes occur in the third quarter of each year. This supports the hypothesis that this group of low wage individuals

[28] Low wage employments include both 'at risk' and low wage control group.

with extremely short employment histories is dominated by summer job workers. Therefore, an increase in the minimum wage is likely to have little impact on their voluntary summer job separations.

ii) individuals with low wage employments < 3 but total employments ³ 3

As shown in Figure 3, most of the individuals excluded from the FE sample have at least three periods of employment, but only one or two of them are considered as low wage. The distribution of the percentage of low wage employment for these workers is presented in Figure 5. On average, only 1 in 5 of their employment periods is defined as low wage. In contrast, individuals in the FE sample have 3 in 5 of their employment periods defined as low wage. Intuitively, the probability of individuals being 'real' low wage workers should be positively correlated with their percentage of low wage employment. If only 1 in 10 of an individual's employment periods is low wage, it is unlikely that he is a 'real low wage worker'. Instead he is likely a high wage worker who works temporarily in some low paid jobs. This suggests that the current wage rate may provide a noisy measure of an individual's permanent marginal product. For example, an individual may be in the low wage group transitorily because of a negative shock to his wage. In addition, a transitory period of low wage employment at the early stage of an individual's employment history may be due to summer jobs. Approximately 50 percent of the low wage employments for this group are in the first two periods of the workers' employment history. As well as having a lower percentage of low wage employment, these workers are also 5 percent less likely to be employed in below minimum wage jobs. Finally, their average earnings in high wage employments are $0.5 higher than in the FE sample. All these observations suggest that the minimum wage might have a smaller impact on this group of effectively 'high wage' individuals.

In summary, this seemingly homogeneous group of low wage workers can be divided into 'transitory' (excluded sample) and 'permanent' (FE sample) low wage workers. An increase in the minimum wage displays opposite effects on these two groups. It has significant impact on the 'permanent' low wage workers employment, but is trivial on the 'transitory' individuals. These different results across the groups highlight the

importance of carefully defining the target group in a minimum wage study. Most previous studies use current wage rates to identify low wage workers as those who are the most likely affected by the change in minimum wage policy. The preceding analysis indicates that relying on current wage rates to make the identification may be insufficient. For individuals who have extremely limited low wage employment histories, current wages may underestimate their marginal products. A close examination of the 'transitory' low wage workers in my sample reveals that they are mainly students working in low paid jobs during the summer, or 'high wage' workers temporarily trapped in low wage positions. In terms of the target group in a supply-and-demand framework, they are less likely to be affected by the minimum wage.

IV. Conclusion

Previous U.S. panel estimates of minimum wage effects have been criticized on the grounds that they are based on comparisons between low wage and high wage workers. As a result, the estimated disemployment effect may be driven by the difference in employment stability between the two groups. Using Canadian panel data for the period 1988 to 1990, I find some empirical support for this criticism. When high wage workers are included in the control group, changes in the minimum wage has a strong negative impact on low wage employment. This result is consistent with other U.S. panel studies of minimum wage. However, the estimated minimum wage effect becomes insignificant once the control group is limited to low wage workers in provinces with no minimum wage change.

A closer examination of the low wage workers in my sample reveals considerable heterogeneity within this group of individuals. For 'transitory' low wage workers, who have less than 3 quarters of low wage employment throughout the sample period, the effects of the minimum wage are virtually zero. There is a significant disemployment effect, however, for the complementary group. For workers with more than 3 quarters of

low wage employment, a minimum wage increase of 8.4 percent leads to a 7 percent decrease in teens' employment. The effect on young adults is even greater at 10 percent.

From a public policy perspective, these results suggest that an increase in the minimum wage is very unlikely to lead to a reduction in overall youth employment level, even for the 'transitory' low wage workers. Yet, it has a significantly negative impact on workers with poor economic prospects. A tradeoff exists between wage level and employment for those who are the primary focus of the minimum wage policy. In order words, when both the treatment and the control groups are defined appropriately, the standard 'textbook prediction' of a negative employment effect can still be retrieved.

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Table 1
Summary Statistics for the Pooled Cross Sections
1988 - 1990

	Teens	Young Adults
No. of Observations	28849	42153
No. of Individuals	4379	5000
Male Ratio (%)	52.27	50.14
Marriage Rate in 1990 (%)	6.86	47.71
Education in 1990 (%)		
0 - 8 Yrs of Education	2.57	6.42
Some Secondary Education	49.14	15.60
Graduated from High School	21.43	30.28
Some Post-Secondary	19.14	19.27
Post-Secondary Diploma	4.29	11.01
University Degree	0.29	10.99
Trade Certificate or Diploma	3.14	7.34
Province (%)		
Newfoundland	6.04	5.65
P.E.I.	2.66	3.10
Nova Scotia	5.90	7.34
New Brunswick	8.73	8.21
Quebec	13.43	16.91
Ontario	22.44	21.50
Manitoba	7.65	7.07
Saskatchewan	8.95	8.39
Alberta	14.02	13.47
British Columbia	10.19	8.38
Avg. Total Employment Periods	6.59	8.44
Avg. Wage ($)	6.78	9.22

Notes: Data are from the LMAS 1988 - 1990 Job File. Teens are defined as individuals aged 16 - 19 in 1988. Young adults are individuals aged 20 - 24 in 1988

Table 2
Percenatge of Individuals "At Risk" by Province

		1988				1989				1990			
		1st Qrt	2nd Qrt	3rd Qrt	4th Qrt	1st Qrt	2nd Qrt	3rd Qrt	4th Qrt	1st Qrt	2nd Qrt	3rd Qrt	4th Qrt
Newfoundland	T		4.00										
	Y		0.65										
P.E.I.	T				10.53		3.85						
	Y				2.86		4.49						
Nova Scotia	T					17.95							
	Y					7.72							
New Brunswick	T						10.34		9.52				6.89
	Y						2.87		2.17				2.72
Quebec	T				12.97				7.33				11.11
	Y				1.98				2.33				3.05
Ontario	T				9.57				4.93				12.16
	Y				1.92				1.84				3.01
Manitoba	T												
	Y												
Saskatchewan	T									13.55		4.66	
	Y									2.13		1.04	
Alberta	T				13.03								
	Y				1.62								
British Columbia	T			17.55					6.71		2.82		
	Y			2.91					3.19		1.03		

Notes: Data are from the LMAS 1988 - 1990 Job File. An individual is defined 'at risk' if there is minimum wage increase at t and his wage rate is between the old and the new minimum wage. T = teens and Y = young adults

Table 3
Description of Control Variables, $X_{i,t}$

Variable	Definition	Group	Source
MAR	= 1 if married, 0 otherwise	$I_{i,t}$	LMAS
SEX	= 1 for male, 0 for female	$I_{i,t}$	LMAS
SEC[1]	= 1 some secondary education. 0 otherwise	$I_{i,t}$	LMAS
HIGH	= 1 graduated from high school, 0 otherwise	$I_{i,t}$	LMAS
PSE	= 1 some post secondary education, 0 otherwise	$I_{i,t}$	LMAS
DIP	= 1 post secondary diploma, 0 otherwise	$I_{i,t}$	LMAS
DEG	= 1 university degree, 0 otherwise	$I_{i,t}$	LMAS
TRD	= 1 Trade Certificate or Diploma, 0 otherwise	$I_{i,t}$	LMAS
UNEMPGP	Difference between Provincial Unemployment Rates for Males (25 - 54) at period t-1 and t	$V_{j,t}$	CANSIM
RGDP	(Provincial GDP at market price) / (Provincial CPI)[2]	$V_{j,t}$	CANSIM
NF	= 1 if individual living in Newfoundland, 0 otherwise	D_p[3]	N/A
PEI	= 1 if individual living in Prince Edward Island, 0 otherwise	D_p	N/A
NS	= 1 if individual living in Nova Scotia, 0 otherwise	D_p	N/A
NB	= 1 if individual living in New Brunswick, 0 otherwise	D_p	N/A
MAN	= 1 if individual living in Manitoba, 0 otherwise	D_p	N/A
ALB	= 1 if individual living in Alberta, 0 otherwise	D_p	N/A
BC	= 1 if individual living in British Columbia, 0 otherwise	D_p	N/A
QUE	= 1 if individual living in Quebec, 0 otherwise	D_p	N/A
SAS	= 1 if individual living in Saskatchewan, 0 otherwise	D_p	N/A

Notes: (1) Base Group has 0-8 years of education (2) Base year = 1986 (3) Ontario is used as the reference group

Table 4
Estimates of the Effects of Minimum Wages
on the Employment Continuation Probability for the "At Risk" Group
All Employed Individuals
(standard errors in parentheses)

	Teens: Ages 16 - 19			Young Adults: Ages 20 -24		
Variable	OLS	Fixed Effects	Random Effects	OLS	Fixed Effects	Random Effects
AtRisk	-0.0688 (0.020)	-0.0634 (0.020)	-0.0638 (0.016)	-0.1479 (0.033)	-0.1031 (0.031)	-0.1204 (0.023)
Sex	-0.0117 (0.005)		-0.0218 (0.006)	0.0091 (0.003)		0.0031 (0.005)
Mar	0.0094 (0.009)	0.0052 (0.018)	0.0100 (0.011)	0.0126 (0.003)	-0.0050 (0.008)	0.0124 (0.004)
SEC	0.0145 (0.021)	-0.0279 (0.045)	-0.00003 (0.023)	0.0531 (0.014)	0.0215 (0.042)	0.0503 (0.015)
HIGH	0.0320 (0.022)	-0.0512 (0.047)	-0.0019 (0.024)	0.0913 (0.013)	0.0200 (0.043)	0.0804 (0.015)
PSE	-0.0261 (0.022)	-0.1102 (0.048)	-0.0663 (0.024)	0.0464 (0.014)	-0.0093 (0.045)	0.0306 (0.015)
DIP	0.0472 (0.023)	-0.0165 (0.054)	0.0055 (0.027)	0.1077 (0.014)	0.0704 (0.046)	0.1017 (0.015)
DEG	-0.0718 (0.055)	-0.1384 (0.094)	-0.1035 (0.051)	0.0973 (0.014)	0.1377 (0.051)	0.0978 (0.016)
TRD	0.0480 (0.027)	-0.0046 (0.058)	0.0205 (0.030)	0.1108 (0.015)	0.0445 (0.045)	0.0990 (0.017)
UnempGp	-0.0074 (0.002)	-0.0049 (0.002)	-0.0070 (0.002)	-0.0081 (0.002)	-0.0060 (0.001)	-0.0069 (0.001)
RGDP	-0.0001 (0.0001)	0.00005 (0.0001)	-0.00005 (0.0001)	-0.00003 (0.0001)	0.00003 (0.0001)	-0.000003 (0.0001)
NF	-0.4832 (0.250)	0.1568 (0.274)	-0.2563 (0.230)	-0.1779 (0.177)	0.1164 (0.183)	-0.1193 (0.165)
PEI	-0.3586 (0.257)	0.0822 (0.295)	-0.1889 (0.237)	-0.1359 (0.182)	0.0533 (0.194)	-0.0996 (0.169)
NS	-0.3277 (0.243)	0.0052 (0.263)	-0.1304 (0.224)	-0.0792 (0.172)	0.1745 (0.178)	-0.0243 (0.160)
NB	-0.3571 (0.246)	0.0113 (0.263)	-0.1712 (0.226)	-0.1144 (0.174)	0.0463 (0.181)	-0.0643 (0.162)
Man	-0.2804 (0.237)	-0.1742 (0.281)	-0.1007 (0.218)	-0.0478 (0.168)	0.1067 (0.179)	-0.0059 (0.156)
Alb	-0.2374 (0.192)	0.1097 (0.204)	-0.0842 (0.177)	-0.0488 (0.136)	0.0294 (0.150)	-0.0079 (0.127)
BC	-0.2401 (0.185)	0.0459 (0.196)	-0.0945 (0.170)	-0.0590 (0.131)	0.0570 (0.149)	-0.0178 (0.122)
Que	-0.1500 (0.113)	0.1948 (0.139)	-0.0540 (0.104)	-0.0450 (0.080)	0.1311 (0.095)	-0.0201 (0.074)
Sas	-0.2736 (0.240)	0.1046 (0.250)	-0.0825 (0.220)	-0.0716 (0.170)	0.0186 (0.180)	-0.0205 (0.158)

Notes: Data are from the LMAS 1988 - 1990 Job File. Empirical specification includes the variables reported plus the quarter and year effects. "AtRisk" is a dummy variable that takes the value 1 if the individual is 'at risk', 0 otherwise. All other control variables are defined in Table 3. Standard errors in the OLS and FE models are corrected by White (1980) procedure.

Table 5
Estimates of the Effects of Minimum Wages
on the Employment Continuation Probability for the "At Risk" Group
Low-wage Individuals
(standard errors in parentheses)

	Teens: Ages 16-19			Young Adults: Ages 20-24		
Variable	OLS All	Fixed Effects N ≥ 3	OLS N ≥ 3	OLS All	Fixed Effects N ≥ 3	OLS N ≥ 3
AtRisk	-0.0007	-0.0987	-0.0729	-0.0528	-0.1122	-0.0966
	(0.024)	(0.031)	(0.030)	(0.041)	(0.040)	(0.048)
Sex	0.0018		0.0063	0.0261		0.0368
	(0.014)		(0.015)	(0.023)		(0.023)
Mar	-0.0520	-0.0031	-0.0427	-0.0229	-0.0321	0.0120
	(0.034)	(0.093)	(0.037)	(0.025)	(0.097)	(0.025)
SEC	0.1248	-0.0709	-0.0388	0.1197	-0.0034	0.1070
	(0.076)	(0.100)	(0.051)	(0.076)	(0.095)	(0.089)
HIGH	0.1292	-0.0941	-0.0590	0.2122	-0.0125	0.1359
	(0.076)	(0.113)	(0.053)	(0.071)	(0.059)	(0.084)
PSE	0.0744	-0.2014	-0.0885	0.1361	-0.0343	0.0709
	(0.077)	(0.121)	(0.054)	(0.072)	(0.087)	(0.086)
DIP	0.0495	-0.3988	-0.1663	0.1228	0.1687	0.0887
	(0.087)	(0.151)	(0.076)	(0.077)	(0.136)	(0.089)
DEG	-0.0297	-0.4649	-0.2463	0.2223	0.1576	0.2330
	(0.162)	(0.249)	(0.156)	(0.078)	(0.119)	(0.083)
TRD	0.1297	-0.2162	-0.0472	0.2196		0.1420
	(0.096)	(0.171)	(0.077)	(0.086)		(0.104)
UnempGp	0.0003	-0.0029	-0.0027	-0.0076	-0.0233	-0.0195
	(0.006)	(0.007)	(0.007)	(0.009)	(0.011)	(0.009)
RGDP	-0.0001	-0.0005	-0.0003	-0.00006	0.0008	0.0001
	(0.0003)	(0.0004)	(0.0004)	(0.001)	(0.001)	(0.001)
NF	-0.4738	-1.0626	-0.7814	-0.2724	1.9377	0.1382
	(0.790)	(0.996)	(0.930)	(1.267)	(1.220)	(1.150)
PEI	-0.3063	-0.8572	-0.7686	-0.2419	-0.0031	0.1819
	(0.811)	(1.102)	(0.956)	(1.301)	(0.185)	(1.190)
NS	-0.2668	-0.7259	-0.7392	-0.1361		0.1636
	(0.768)	(1.056)	(0.902)	(1.230)		(1.117)
NB	-0.3237	-1.3589	-0.7647	-0.1849		0.2397
	(0.777)	(0.979)	(0.912)	(1.242)		(1.128)
Man	-0.2006		-0.6833	-0.1214	0.2564	0.2330
	(0.750)		(0.879)	(1.200)	(0.250)	(1.089)
Alb	-0.2347	-0.9697	-0.5842	-0.1051	-0.0394	0.1632
	(0.607)	(0.855)	(0.713)	(0.971)	(0.318)	(0.881)
BC	-0.2094		-0.5720	-0.1851	-0.0464	0.1260
	(0.582)		(0.684)	(0.932)	(0.353)	(0.849)
Oue	-0.1696		-0.3475	-0.0689		0.1036
	(0.355)		(0.416)	(0.570)		(0.520)
Sas	-0.2151	-0.9887	-0.6977	-0.1763		0.2034
	(0.757)	(0.979)	(0.889)	(1.211)		(1.101)

Notes: See notes in Table 4. "AtRisk" is a dummy variable that takes the value 1 if the individual is 'at risk', 0 if the individual is considered as low-wage control. N = Number of low-wage employment periods. All standard errors are corected by White (1980) procedure.

Figure 1. Distribution of Total Employment Periods by Age

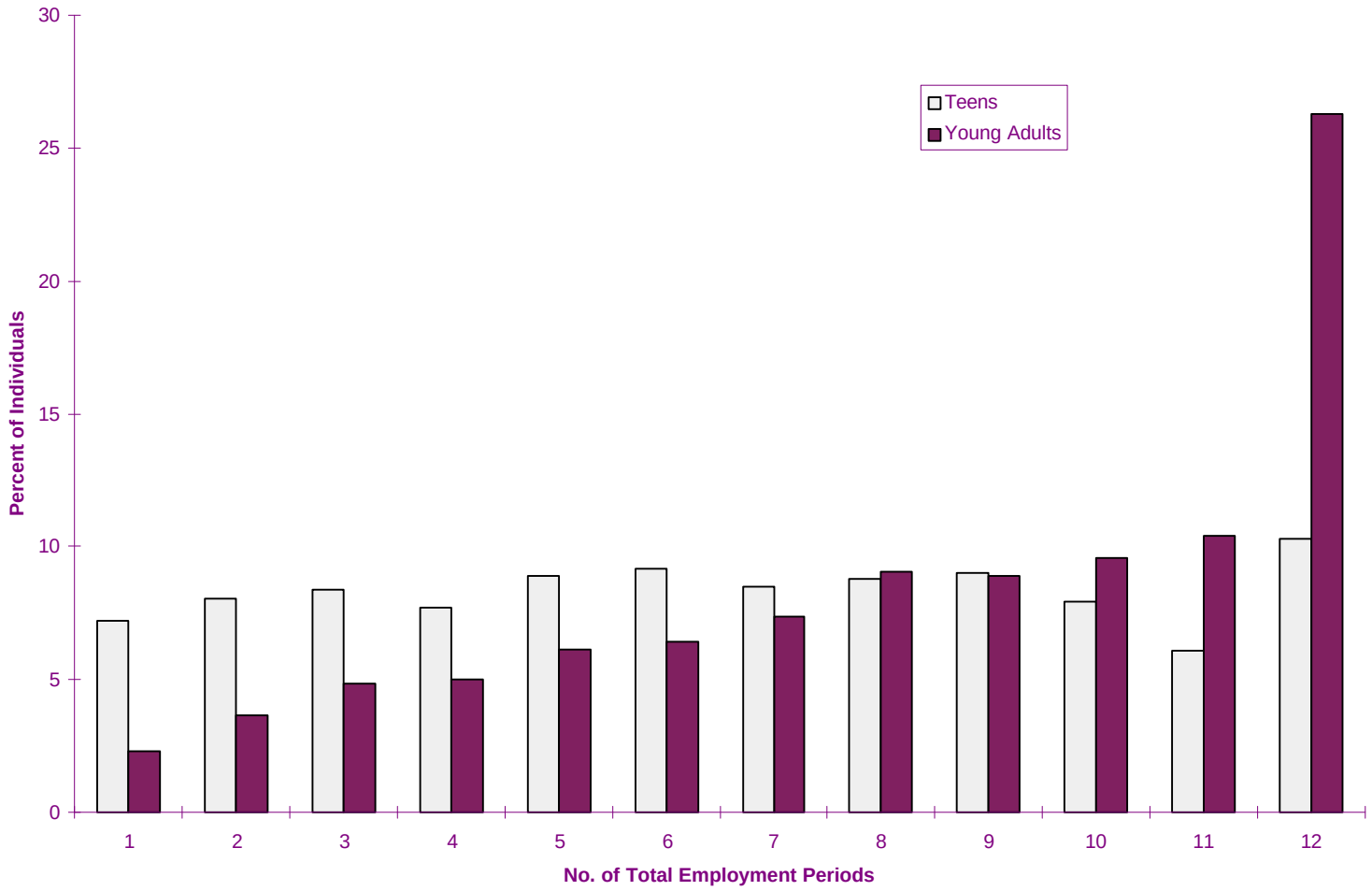
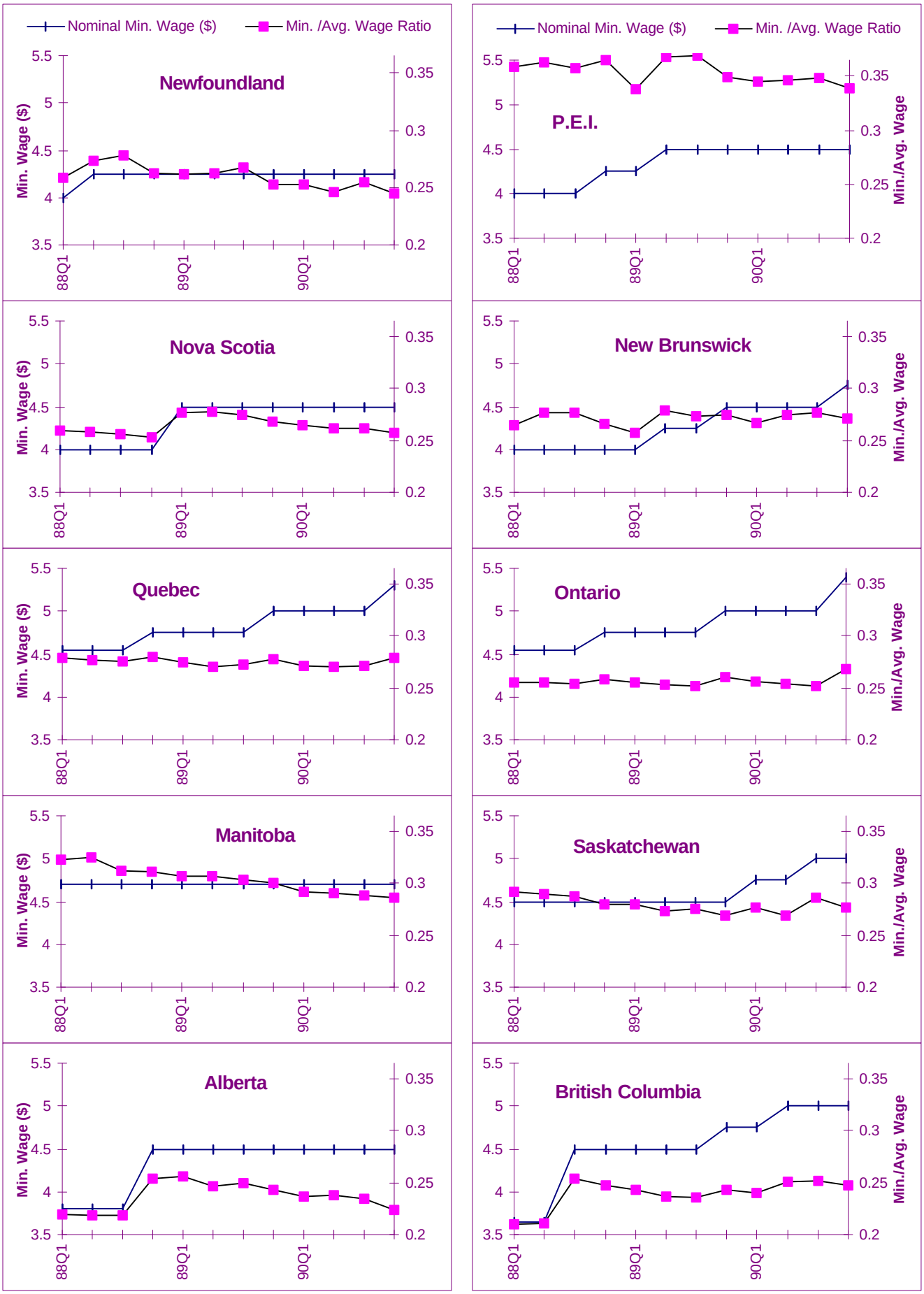
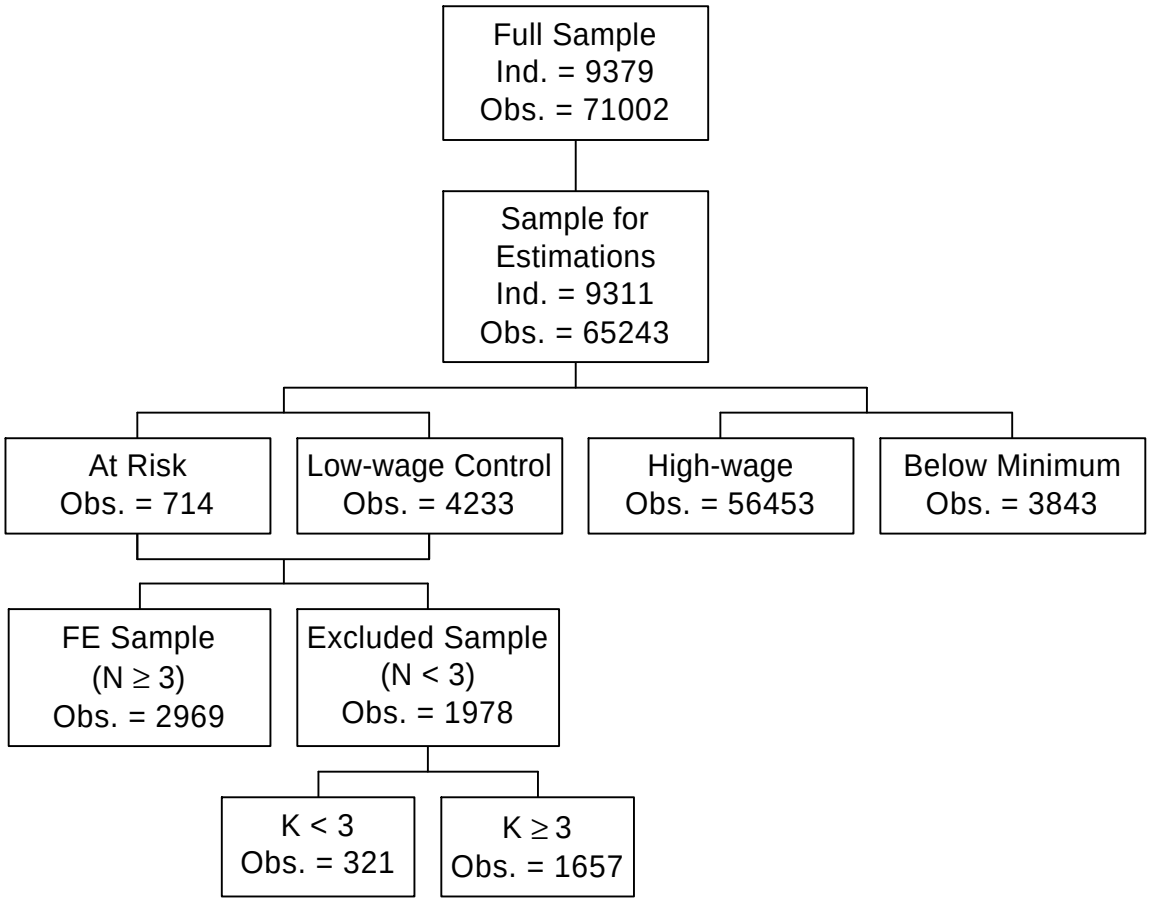


Figure 2. Minimum Wages by Province



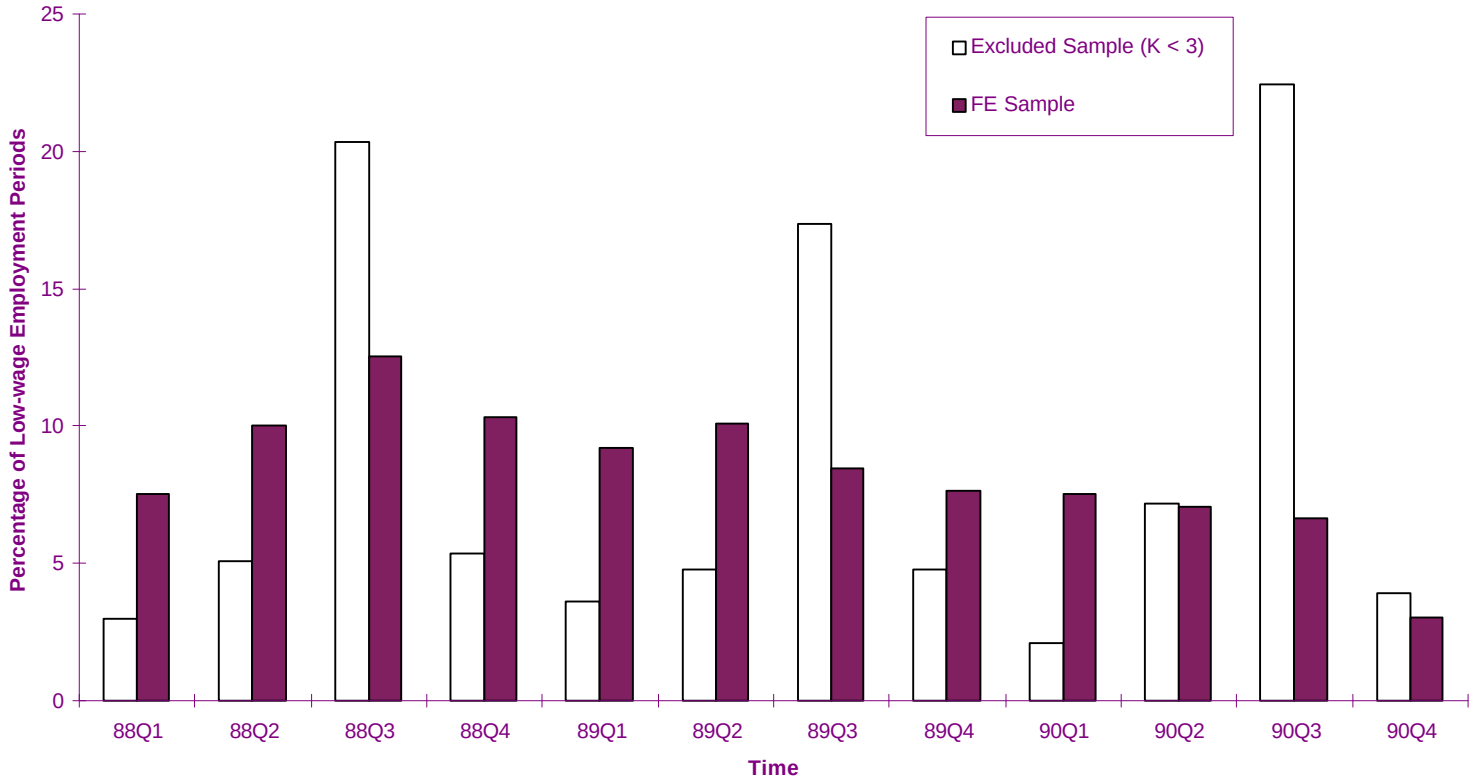
Notes: The Nominal Min. Wage is measured in current dollars. The Min./Avg. Wage is the ratio of the relevant minimum to the provincial average manufacturing wage including overtime.

Figure 3. Detailed Breakdown of the Sample



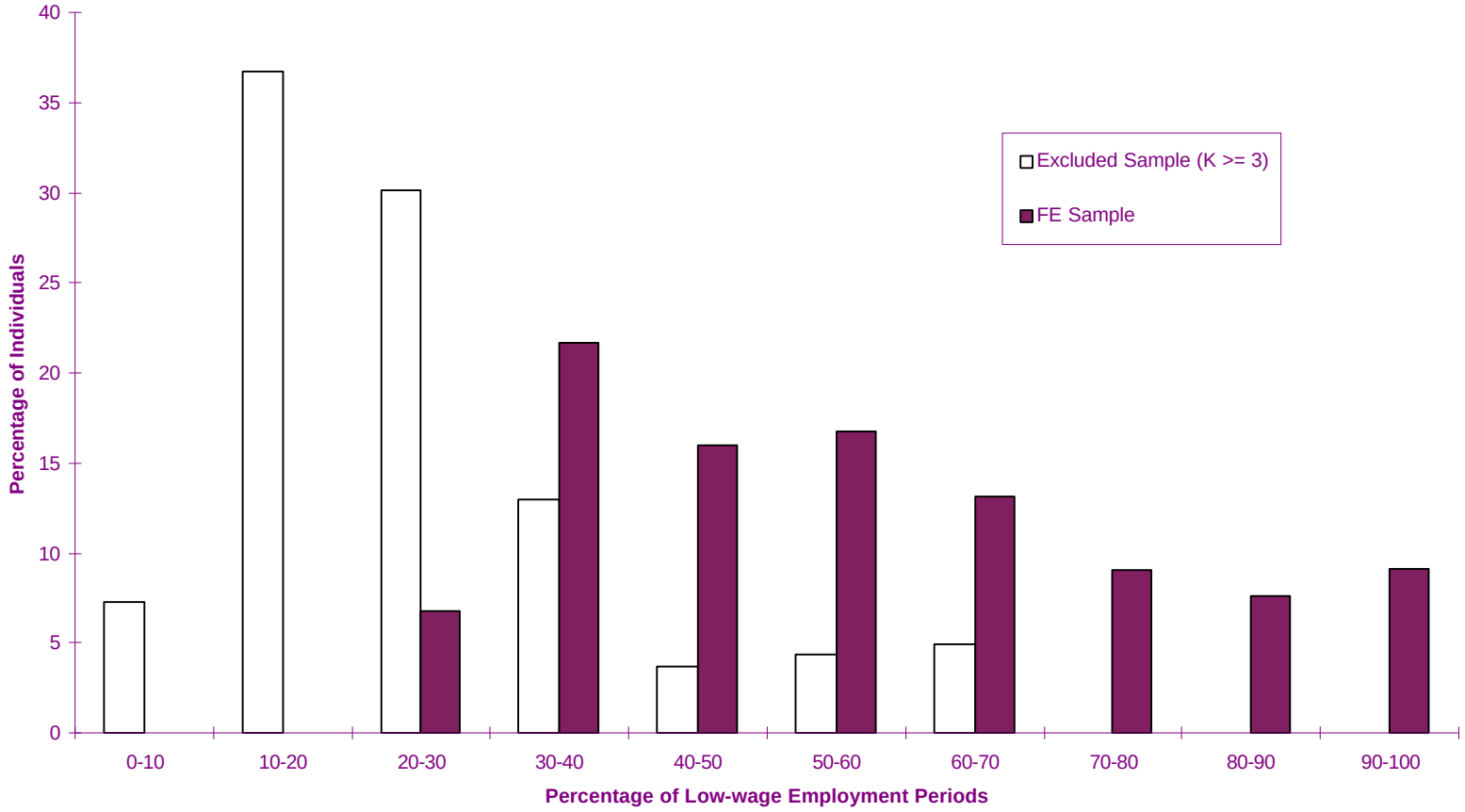
K = Total periods of employment between 1988 - 90
N = Number of low-wage employments between 1988 - 90

Figure 4. Distribution of Low-wage Employment Periods across Time



Notes: K = Total periods of employment between 1988 – 90. The samples are defined in the notes to Figure 3.

Figure 5. Distribution of Percentage of Individuals with Low-wage Employments



Notes: See notes in Figure 4.